of grass blades without risking contact and injury from the tentacles. These results support those of a previous study that, despite having tested grass placed a full 30 cm from anemones, concluded that *C. gigantea* presence did not affect turtle grass herbivory (Babineau et al. 1999).

Our finding that substrate does not influence the level of herbivory suggests that the risk of herbivory does not play a major role in inhibiting turtle grass growth on rocks. Environmental factors, such as intense wave disturbance and lack of suitable substrate for germination and root establishment, are probably stronger determinants of low turtle grass recruitment on rocks.

Indirectly, *C. gigantea* may benefit from not creating a favorable microhabitat for turtle grass. *C. gigantea* naturally grows interspersed among turtle grass. The two species, therefore, compete for limited amounts of light. If *C. gigantea* sheltered turtle grass, grass growth rate and blade height would increase. Simultaneously, the light level penetrating to anemone tentacles would decrease. Without sufficient light, photosynthesis of *C. gigantea* zooxanthellae would diminish, thereby lowering anemone fitness. Conversely, if small fish are an important component of anemone diet and if turtle grass serves as a refuge for small fish, then the absence of grass or the presence of short, cropped grass proximate to an anemone would reduce the immediate prey density around, and decrease the foraging opportunities of, the anemone. Ultimately, *C. gigantea* must weigh the costs of shading with those of decreased prey availability; the relative benefits of obtaining nutrients from its zooxanthellae symbionts vs. capturing live prey lies delicately in the balance. *C. gigantea* and turtle grass coexistence suggests that species must sometimes tolerate sub-optimal growing conditions in order to maintain viable populations within the highly competitive coral reef ecosystem.

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The relationship between herbivory and epibiont height on *Thalassia testudinum*

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Abstract: Parrotfish (*Scaridae* spp.) graze on seagrass (*Thalassia testundinum*) in order to feed on epibionts which grow on the blades. Previous studies have shown that parrotfish use visual cues to identify where epibionts are located, but it has not been determined whether the fish are searching for the top of the blades or the epibionts themselves. We hypothesized that the height of epibionts on seagrass blades determines the height at which parrotfish forage, and predicted that parrotfish will graze more frequently on regions of blades with epibionts. We also predicted that parrotfish will prefer to graze on blades with epibionts positioned higher than lower on the leaves. We measured the presence and absence of grazing on blades on which we removed epibionts from one half of the blade and alternated the relative heights of the two regions in the field. Parrotfish grazed most on the regions of seagrass blades containing epibionts, and foraged more on these when they were positioned higher in the water column. Parrotfish may prefer higher epibionts because they are easier to access, but they will forage lower on the blade if given the choice between high blades without epibionts and low blades with epibionts.

Key Words: turtle grass, seagrass, parrotfish, Scaridae

Introduction

Dense beds of seagrass (*Thalassia testudinum*) grow in the back reef of Discovery Bay, Jamaica. Parrotfish (*Scaridae*), while unable to digest the actual plant, receive nutritional benefits from the epibionts that grow on the blades of the seagrass. These epibionts, consisting of calcareous and filamentous algae, diatoms, polychaete worms, and sea anenomes, are most dense on the tops and are sparse on the bottoms of the blades (pers. obs.). Although parrotfish may rely on visual cues to locate epibionts, it is unclear whether they are grazing on the grass because they see the epibionts, or if they simply always graze on the tops of the blades and therefore where the epibionts are most abundant. We hypothesized that the position of the epibionts on the seagrass blades is an important factor in determining where the fish forage. We predicted that parrotfish will graze more frequently on the epibiont-covered portion of leaves when this area is high rather than low in the water column, and thus perhaps more visible. We further predicted that parrotfish will forage more often on lower regions of blades with epibionts than on regions without epibionts.

Methods

Our study was conducted at the Discovery Bay Marine Biology Laboratory in Discovery Bay Jamaica on 25 – 26 February. We harvested 100 seagrass blades from the west back reef, cut the blades to 15 cm and removed the epiphytes from the lower 7.5 cm of each blade. To test for parrotfish grazing preference, we created two treatments. The first treatment had blades oriented normally with the epibionts positioned on the tops of the blades, and the second had the orientation of the blades reversed with the epibionts positioned downwards (Figure 1). Blades were grouped by treatment in bunches of 10, which were held together by a clothespin, and weighed down by a metal bolt. There were five bunches of 10 for each treatment. We placed the treatments in the backreef in a seagrass bed. Two bundles, one from each treatment, were paired and positioned ~ 0.5 m apart. All pairs were within 2 m of each other. The experiment was left in the seagrass bed for 22-hrs beginning at 16:00, after which the blades were collected and assessed for the presence

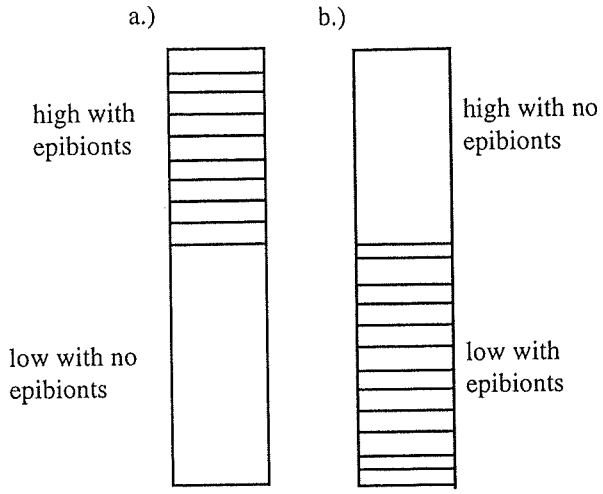

Figure 1. a.) Treatment with epibionts only on the top portion of the blade (normal). b.) Treatment with epibionts only on the bottom portion of the blade (reversed).

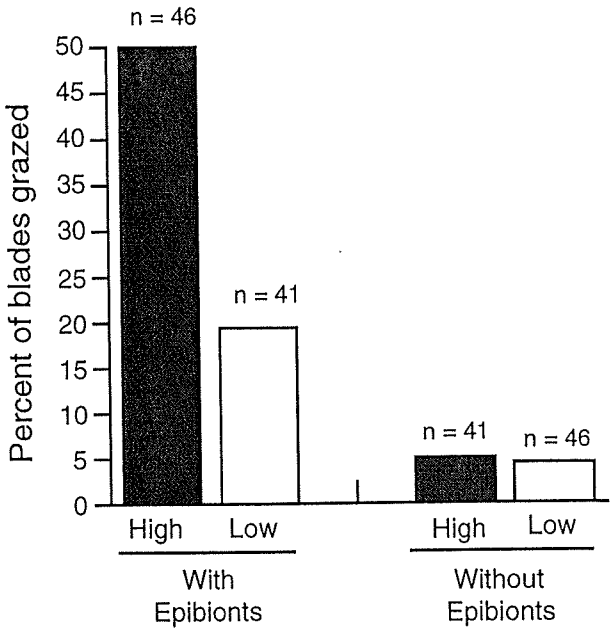

Figure 2. The effect of epibionts and leaf position (high or normal vs. low or reversed; see Figure 1) on parrotfish grazing on *Thalassia testundinum.*

or absence of parrot fish grazing in the blade sections with and without epibionts. Nine blades with epibionts oriented up and four blades with epibionts oriented down had been completely removed by the parrotfish and were not used in analysis. We used Chi-square tests to analyze differences in grazing occurrence between epibiont regions and non-epibiont regions and between upper and lower portions of blades. This analysis assumes that each occurrence of grazing is independent of other grazing events, an assumption not guaranteed in our experimental design. Ideally, each blade would have been placed individually in the reef.

Results

Areas of the blades with epibionts were grazed more than areas without epibionts (Chi-square = 27.46, df = 1, $p < 0.001$). Upper portions of blades with epibionts were grazed more than lower portions of blades with epibionts (Chi-square = 12.37, df = 1, $p < 0.01$). Parrotfish preferred to graze on blades with epibionts on the upper portion, followed by blades with epibionts on the lower portion, and then blades without epibionts (Figure 2).

Discussion

As predicted, parrotfish do not randomly graze on seagrass blades, nor do they only eat the top, most accessible parts of the blades. Instead, both the presence of epibionts and their height affected the height at which the fish grazed. Parrotfish prefer to graze on regions of blades with epibionts, and they foraged more frequently on blades with epibionts near the top of the blade than on blades with epibionts near the base of the blade. A possible explanation for this trend is that epibionts at the top are more easily detected and grazed upon and therefore preferred to epibionts lower down. When given the choice between low, epibiont-covered regions of grass blades and high regions of grass without epibionts, the fish chose the former. Probably, the nutritional benefits of the epibionts far outweigh any costs that are attached with foraging lower on the blade.